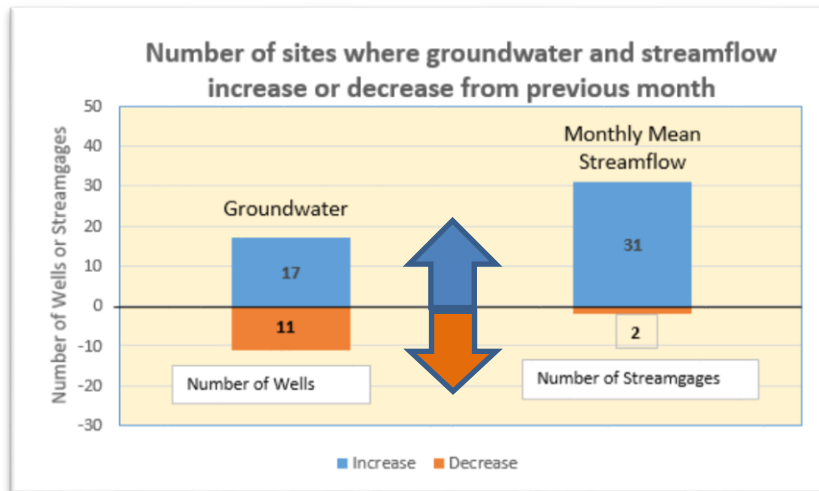


## U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

**December 2016 Highlights:** Sixty-one percent of groundwater levels increased since November and 61 percent rank in the normal range. Monthly mean streamflows increased at 94 percent of streamgages since November and 64 percent of the gages rank in the normal range. Freshwater flow to the Chesapeake Bay was below average. Precipitation was below average at five Mid-Atlantic weather stations.



### Why is it important for the USGS to collect and analyze water-resources data?

USGS water data are valuable to the public, researchers, water managers, planners, and agricultural users, especially during extreme conditions like floods and droughts. The USGS is known for its consistent measurement techniques and the most extensive set of historical groundwater and streamflow data available to the public. Since these long-term data were collected during wet and dry periods, they can be used to assess how water resources respond to changes in temperature and precipitation and see how current data compare to the past. The uniformity of the dataset enables multi-state comparisons and other comparative statistical analyses that better inform policy makers of possible water-resources conditions they might encounter in the future.

The sites used in this water summary were carefully selected to have long-term data and show the response of streamflow and groundwater levels to weather conditions rather than effects from human influences. Of the USGS sites presented in this summary, 13 wells and 29 streamgages have more than 50 years of data. The current streamflow and groundwater data are ranked in comparison to the historical record and summarized. In addition to groundwater and streamflow data, this summary includes precipitation and temperature data, reservoir levels, and freshwater streamflow to the Chesapeake Bay to give a more complete picture of the region's water resources.

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## USGS December 2016 Water Conditions Summary

Although December precipitation was below normal for the second consecutive month, groundwater levels increased between November and December at 61 percent of the wells and streamflows increased at 94 percent of the streamgages used to monitor the response of water resources to changes in weather conditions in Maryland, Delaware, and the District of Columbia. The improvement between November and December may be attributed to the unusually low November water levels, including 6 wells below the 10<sup>th</sup> percentile, three of which were at record low November levels, and streamflow below the 10<sup>th</sup> percentile at 15 streamgages.

In December, 61 percent (17 of 28 USGS observation wells) of the groundwater levels were in the normal range (25<sup>th</sup>-75<sup>th</sup> percentiles). Groundwater levels were below normal at the remaining 11 wells, and 6 of these wells were below the 10<sup>th</sup> percentile.

Monthly mean streamflows were in the normal range at 64 percent (21 of 33 selected USGS streamgages). Streamflow was below normal at 12 streamgages, all of which were between the 10<sup>th</sup> and 24<sup>th</sup> percentiles.

Freshwater flows to the Chesapeake Bay were below average, and precipitation was below average at five Mid-Atlantic weather stations in December. Hydrologic and weather data have not been reviewed and are therefore provisional and subject to revision.

A **percentile** is a value on a scale from 0 to 100 that indicates the percent of a distribution that is equal to or below it. A percentile between 25 and 75 is considered normal. For example, a groundwater level in the 90th percentile is equal to or greater than 90 percent of the values recorded for that month.

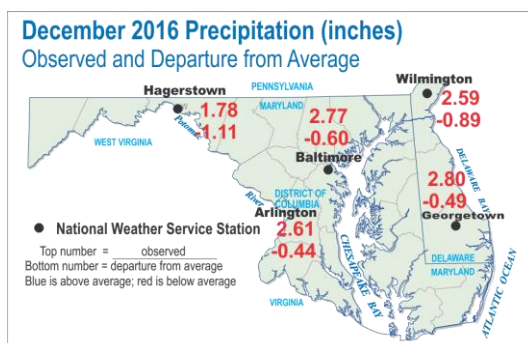
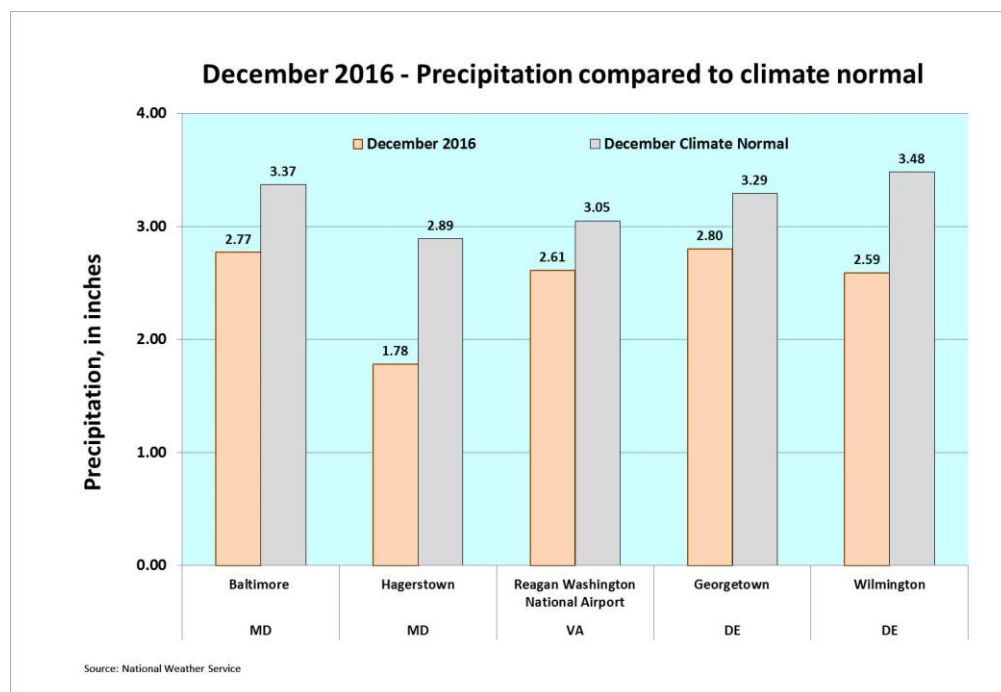
# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Weather Conditions

Five Mid-Atlantic National Weather Service (NWS) stations are used to present monthly precipitation and temperature data. The NWS uses averages of data over the 30-year climate normal period between 1981 and 2010. Data from the Middle Atlantic River Forecast Center (MARFC) is used to show precipitation for the past 365 days. During drought periods, the status from the National Drought Mitigation Center (U.S. Drought Monitor) is included.

## December 2016 Precipitation

December precipitation (tan bars on graph) compared to the precipitation averaged over the 30-year climate normal period (gray bars on graph) was below normal at all five Mid-Atlantic NWS weather stations. The precipitation map shows the December precipitation and the departure from average as red text for below normal. Precipitation was lowest in western Maryland, at Hagerstown with 1.78 inches, which is 1.11 inches less than normal for December (2.89 inches). Except for the low point in Hagerstown, the precipitation amounts were all within 0.21 inches of one another, ranging from 2.59 inches at Wilmington, Delaware to a high of 2.80 inches at Georgetown, Delaware.



## National Weather Service Stations

### Baltimore =

Baltimore/Washington International  
Thurgood Marshall Airport (BWI)

### Georgetown =

Georgetown, Sussex County Airport

### Hagerstown =

Hagerstown Regional Airport

### Arlington =

Ronald Reagan Washington National Airport

### Wilmington =

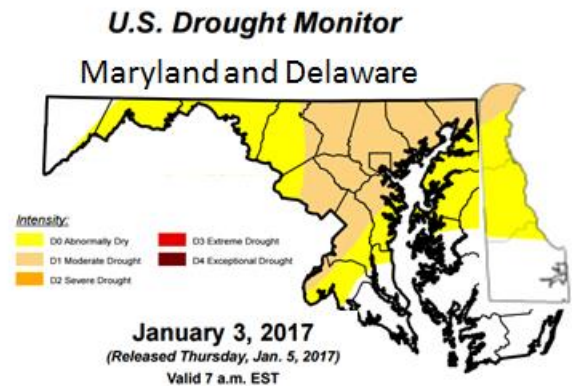
New Castle Airport

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Drought Status

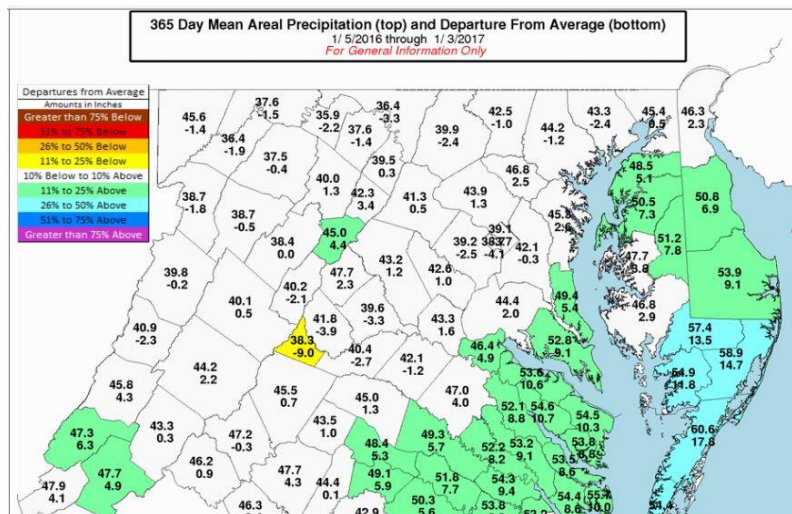
Despite increases from November to December in groundwater levels and streamflow at the majority of monitored sites, below normal groundwater levels and monthly mean streamflow reflect the below normal precipitation in November and December. According to the U.S. Drought Monitor, as of January 3, 2017, 32.68 percent of Maryland, and 10.58 percent of Delaware were at the moderate drought level (D1). See this website for the most recent drought status:

<http://droughtmonitor.unl.edu/Home/RegionalDroughtMonitor.aspx?northeast>



## Long-term or 365 day Precipitation

The NWS's MARFC 365-day precipitation map is used to show the long-term precipitation status for Maryland, Delaware, and the District of Columbia, although Virginia and West Virginia are also shown on the map. There are 23 counties in Maryland, 3 counties in Delaware, and the District of Columbia. In December, the MARFC 365-day precipitation totals showed that 18 counties in



Maryland, Delaware, and the District of Columbia were considered average (10 percent below to 10 percent above), and 5 counties were 11 to 25 percent above average. Precipitation in an additional three counties on the southern end of the Delmarva Peninsula (Somerset, Wicomico, and Worcester Counties, Maryland), were 26 to 50 percent above average, ranging from 13.6 to 14.8 inches above average.

## December 2016 Temperatures

December temperatures were above average at all five NWS Mid-Atlantic weather stations, with a temperature range from 0.9 degrees to 2.9 degrees Fahrenheit above average. The largest departure from average (for 6 consecutive months) was at the weather station in Hagerstown, Maryland, where the average temperature was 36.9 degrees. The average temperature at this weather station was the lowest of the five weather stations. The highest average December temperature was 41.8 degrees in Arlington, Virginia.

Sources: National Weather Service and Middle Atlantic River Forecast Center (MARFC)  
MD and DC: <http://www.weather.gov/climate/index.php?wfo=lmx>  
DE: <http://www.weather.gov/climate/index.php?wfo=phi>  
MARFC: [http://www.weather.gov/marfc/Precipitation\\_Departures](http://www.weather.gov/marfc/Precipitation_Departures)

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Groundwater

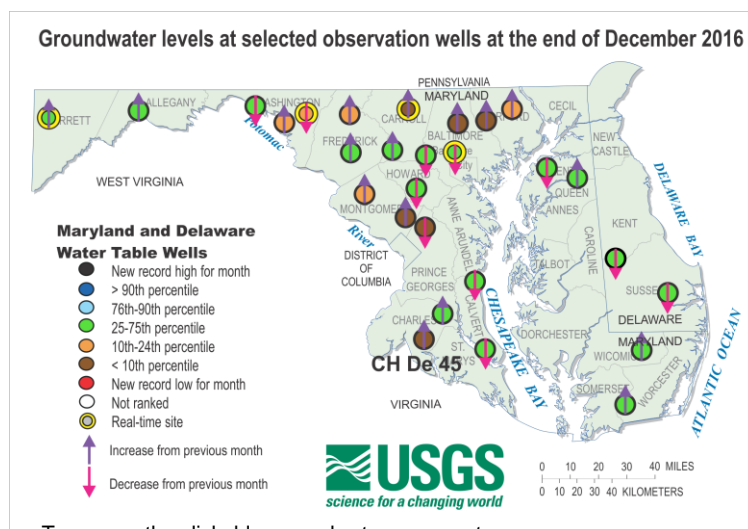
The USGS monitors groundwater levels in surficial or unconfined aquifers, providing observations that can be compared to both short-term and long-term changes in weather conditions. The groundwater wells used for the monthly water summary were selected based on the following criteria:

- Located in a surficial or unconfined (water-table) aquifers
- Open to a single, known hydrogeologic unit/aquifer
- Groundwater hydrograph generally reflects response to weather
- No indicated nearby pumpage, and likely to remain uninfluenced by pumpage or changes related to human activities
- Minimum period of record is 10 years of continuous/monthly records
- Minimally affected by irrigation, canals, drains, pipelines, and other potential sources of artificial recharge
- Well has a casing – dug wells are generally not used
- Water levels show no apparent hydrologic connection to nearby streams
- Well rarely goes dry
- Long-term accessibility likely, such as on public land

In the Maryland, Delaware, and the District of Columbia region it is useful to compare current data to data during the historic droughts of 2002 and in the 1960s. There are 11 wells that have over 60 years of groundwater data which allows comparison to both of these drought periods. Of the 28 USGS observation wells used for this summary, 23 have more than 30 years of groundwater data as of 2017.

## December 2016 Groundwater Levels

In December, groundwater levels increased at 17 of 28 wells (61 percent) since November, however, the groundwater levels remain below normal at 11 wells. On the groundwater map, arrows on the well symbol indicate whether the groundwater level increased or decreased over the past month. Sixty-one percent of the groundwater levels were within the normal range. There were five wells with below normal groundwater levels (between the 10<sup>th</sup> and 24<sup>th</sup> percentiles), and six wells with groundwater levels below the 10<sup>th</sup> percentile in Maryland. Groundwater levels in Delaware and on the Delmarva Peninsula were in the normal range in December.



To access the clickable groundwater map, go to:

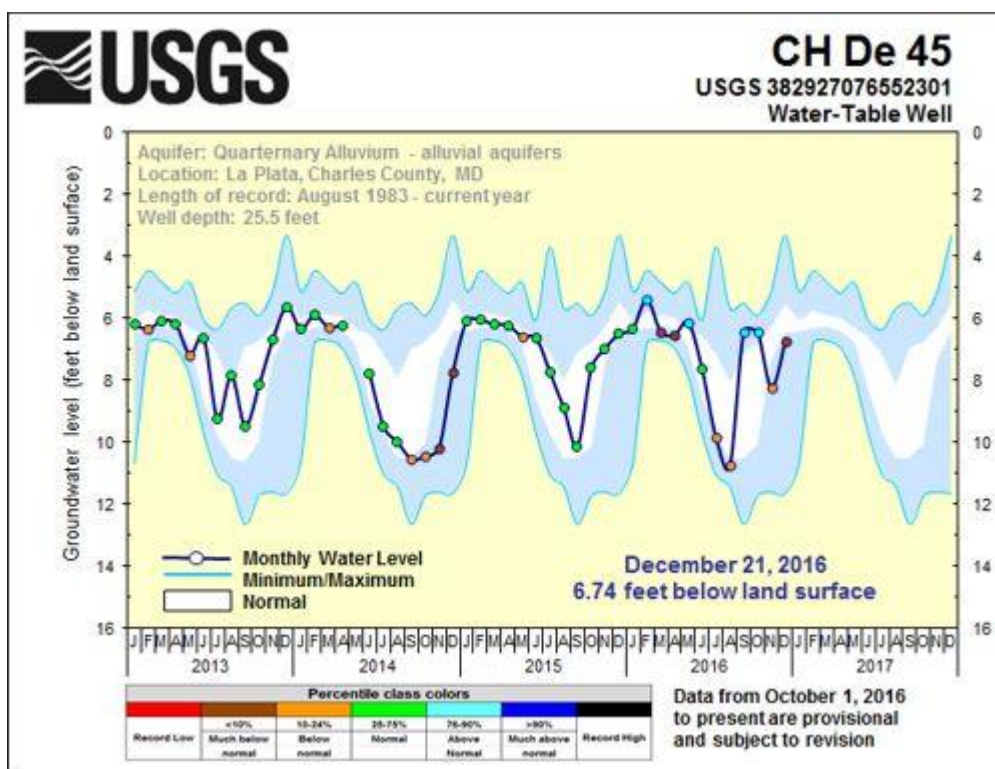
[http://md.water.usgs.gov/groundwater/web\\_wells/current/water\\_table/counties/](http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties/)



## U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

Although the groundwater level for USGS observation well CH De 45, in Charles County, Maryland rose 1.5 feet from 8.24 feet below land surface in November to 6.74 feet below land surface in December, the groundwater level remained below normal. This groundwater level ranks below the 10<sup>th</sup> percentile. Normal December groundwater levels at this well range from 5.56 to 6.46 feet below land surface.

The 5-year hydrograph shows groundwater levels as a dark blue line. Each monthly measurement is colored according to the percentile rank compared to the historical values at the site for the month. The normal range is displayed as a white band, and is based on the period of record. The maximum water level is at the top of the upper blue section, and the minimum water level is at the bottom of the lower blue area in the graph.



Five-year groundwater hydrographs can be viewed at:  
[http://md.water.usgs.gov/groundwater/web\\_wells/current/water\\_table/counties](http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties)

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Streamflow

Streamflow data are used most commonly for assessing water supply and to determine the risk of droughts and floods. Streamflow data are also used to calculate loads of chemical constituents, and to assess how biological communities are affected by hydrologic conditions.

The USGS streamgages chosen for the monthly water summary were selected based on the following criteria:

- Minimum period of record is 10 years of continuous data
- Watershed areas greater than 5 square miles
- Streamflow is not regulated, such as by a dam or diversion, and it has relatively natural flow
- Streamflow data reflect a response to weather conditions
- Most of the surrounding area and watershed are not urban

Of the 33 streamgages used in this summary, 22 have more than 60 years of data, allowing for comparison to the historic droughts of 2002 and in the 1960s. All 33 streamgages have at least 30 years of monthly mean streamflow data.

## December 2016 Streamflow

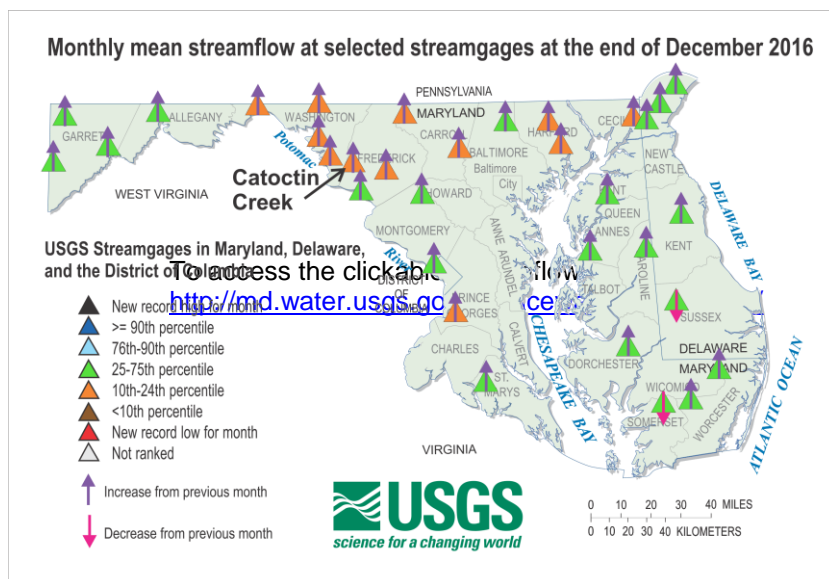
Despite below-average precipitation in December, streamflow increased at most streamgages from the low levels in November. December mean streamflows were normal or below normal at all 33 USGS streamgages used to monitor response to weather conditions in Maryland, Delaware, and the District of Columbia. Arrows on the streamgage symbol indicate whether the monthly mean streamflow increased or decreased over the past month.

Monthly mean streamflows increased at 94 percent of streamgages since November and were in the normal range (25<sup>th</sup>-75<sup>th</sup> percentiles and green on map) at 64 percent or 21 of 33 selected USGS streamgages. Streamflows were below normal (orange on map) at 36 percent or 12 streamgages, all of which were between the 10<sup>th</sup> and 24<sup>th</sup> percentiles and most were located in the northern-central counties in Maryland.

Monthly mean streamflow was normal at all selected streamgages in Delaware, on the Delmarva Peninsula, and in the District of Columbia.

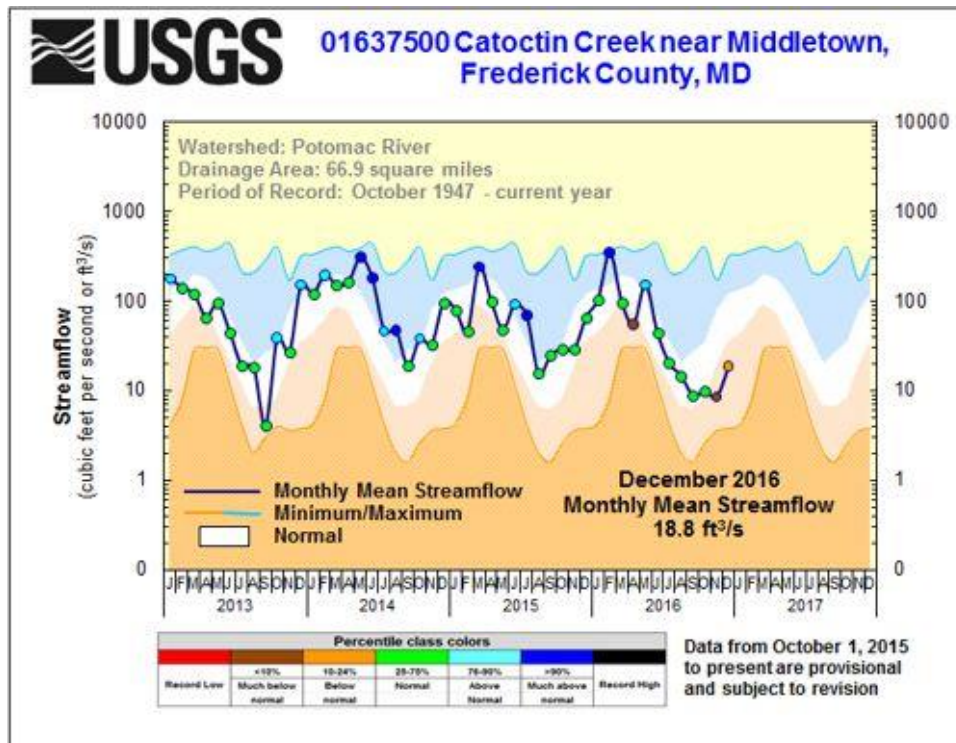
Due to incomplete streamflow data, likely caused by ice and frozen streams interfering with natural streamflow, estimates were made for eight streamgages (indicated on the corresponding hydrographs – see link below) in December. These data have not been reviewed and are therefore provisional and subject to revision.

Catoctin Creek near Middletown in Frederick County, Maryland is an example of one of the 31 streamgages where the monthly mean streamflow increased between November and December.



## U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

Although streamflow increased in December, it remained below normal at 18.8 cubic feet per second (ft<sup>3</sup>/s). Normal flows for December range from 35.0 ft<sup>3</sup>/s to 120.7 ft<sup>3</sup>/s at this streamgage, based on 69 years of data.



Five-year hydrographs can be viewed at:  
<http://md.water.usgs.gov/surfacewater/streamflow/>

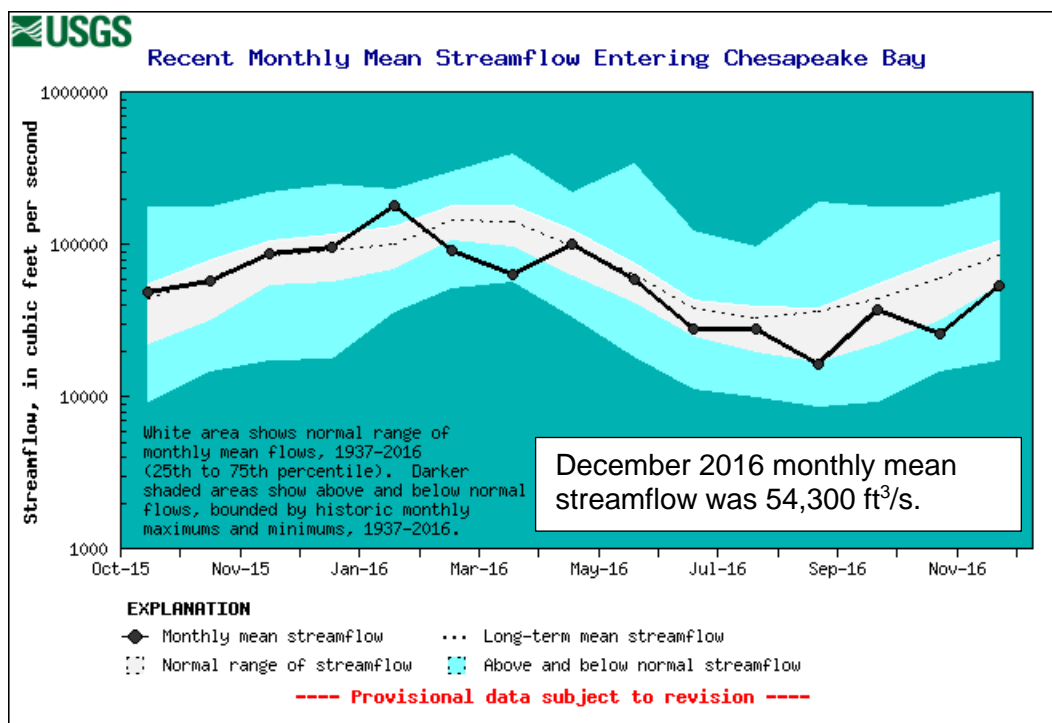
The dark line in the 5-year hydrograph represents the monthly mean streamflow for this period, and the white band shows the normal range (25<sup>th</sup>-75<sup>th</sup> percentiles) based on the period of record. The maximum monthly mean streamflow is at the top of the blue shaded section, and the lowest monthly mean streamflow is at bottom of the tan area. Each monthly mean measurement (each circle) is colored according to the percentile rank compared to the historical data for the month.



# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Estimated Streamflow to the Chesapeake Bay

The USGS estimates monthly mean fresh streamflow to the Chesapeake Bay using streamflow measurements from the Susquehanna, Potomac, and James Rivers. In December 2016, the monthly mean freshwater flow to the Chesapeake Bay was 54,300 ft<sup>3</sup>/s, which is below normal. The long-term December average (mean) is 85,200 ft<sup>3</sup>/s, and the normal range is between 54,500 ft<sup>3</sup>/s and 107,000 ft<sup>3</sup>/s (25<sup>th</sup> - 75<sup>th</sup> percentiles of all December values). The statistics are based on an 80-year period of record.



Runoff in the Chesapeake Bay watershed carries pollutants, such as nutrients and sediment, to rivers and streams that drain to the Bay. The amount of water flowing into the Chesapeake Bay from its tributaries has a direct impact on how much pollution is in the estuary, and it also affects the salinity levels that are important for the survival of fish, crabs, and oysters, with regard to the location and size of breeding/reproductive zones. Generally, as river flow increases, more nutrient and sediment pollution enters into the Bay.

More information on freshwater flow to the Bay can be found here:

<http://md.water.usgs.gov/waterdata/chesinflow/>

# U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia Monthly Water Conditions Summary

## Baltimore and Patuxent Reservoir Levels

Baltimore City's Department of Public Works provides drinking water from three reservoirs to 1.8 million people daily in Baltimore City and parts of Baltimore County and portions of Anne Arundel, Carroll, Harford and Howard Counties. Available reservoir storage at the end of December 2016 in the Baltimore reservoirs (Loch Raven, Liberty, and Prettyboy) was 67.67 billion gallons or 89.65 percent of available storage capacity (total or full storage is 75.85 billion gallons of water).

The Triadelphia and Duckett Reservoirs serve 1.8 million residents in parts of Howard, Montgomery, and Prince George's Counties in suburban Maryland around the District of Columbia and are managed by the Washington Suburban Sanitary Commission (WSSC).

The stored water quantity at the end of December 2016 was 5.8 billion gallons, which is 54.40 percent of normal storage capacity for these reservoirs. Normal storage refers to the volume that is useable for water supply. The full capacity of the Patuxent reservoirs is 12.09 billion gallons, which is higher than normal storage (10.6 billion gallons) and therefore values can exceed 100 percent of normal storage.

December 2016	Percent available/normal storage	Volume (billion gallons)
<b>Baltimore Reservoirs</b>		
<b>Baltimore City – Environmental Services Division</b>		
<b>Available storage is 75.85 billion gallons</b>		
Liberty	86.47%	31.82
Loch Raven	97.88%	20.75
Prettyboy	84.59%	15.1
<b>Total</b>	<b>89.65%</b>	<b>67.67</b>
<b>Patuxent Reservoirs</b>		
<b>Washington Suburban Sanitary Commission</b>		
<b>Normal storage is 10.6 billion gallons</b>		
Triadelphia	59.10%	3.31
Duckett	49.69%	2.49
<b>Total</b>	<b>54.40%</b>	<b>5.8</b>

